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## Summary

The use of low-field magnetic resonance imaging (MRI) and ultrasonography (USG) for imaging ligaments and tendons in physiological and pathological conditions of the canine carpal joint is increasingly being utilized in the diagnosis of injuries and diseases. Compared to radiography, which is limited to the evaluation of bony structures, these advanced imaging techniques allow for a more comprehensive approach. Limping caused by ligament or tendon injuries requires more precise diagnostics. Due to their excellent imaging capabilities, both MRI and USG play a crucial role in evaluating various physiological and pathological conditions with exceptional detail and precision.

The aim of this study was to evaluate the application of ultrasonography and low-field magnetic resonance imaging (MRI) in imaging selected anatomical structures of the canine carpal joint. For this purpose, MRI and USG examination protocols were developed, enabling the determination of detailed anatomy of the joint's tendons and ligaments. Another goal was to develop a model that would determine the average dimensions of selected structures of the wrist joint based on body weight and measurements of the thoracic limb. Additionally, the usefulness of the developed model in diagnosing diseases and injuries of the carpal joints in dogs was discussed.

The study was conducted on a group of 30 dogs with a normal body condition score (BCS) and no signs of musculoskeletal system-related diseases. In a subgroup of 4 dogs, which were not included in the main stage of the experiment, imaging protocols for radiographic,

ultrasonographic, and low-field magnetic resonance imaging of the carpal joint were established. Before the imaging examinations, the body weight of each animal was determined, and measurements of the area around the right carpal joint were performed using a measuring tape. Subsequently, radiographs of the right carpal joint in lateral and oblique projections were obtained. The radiographs were used to determine the mean values of measurements of the intermedioradial and accessory carpal bones. Ultrasonographic examination of the right carpal joint included visualization of the superficial and deep flexor tendons in transverse and sagittal sections, as well as the medial accessoriometacarpal ligament in the sagittal plane. Subsequently, MRI of the carpal joint was performed using a low-field magnetic resonance imaging system with a magnetic field strength of 0.245 T. The examination included T1-weighted and T2-weighted image sequences in three planes: sagittal, frontal, and transverse. Based on the obtained images, measurements of the same structures of the joint as in radiographs and ultrasonograms were made. The data collected in text files and spreadsheets were subjected to statistical analysis using Python and R programming languages. The Shapiro-Wilk test was conducted to verify the normality of data distribution, and parametric analysis methodology was applied. The correlation between measurements obtained using MRI, radiography, and ultrasonography and body mass and thoracic limb parameters was established based on Pearson's correlation. Linear regression models were constructed, and the quality of the models was assessed based on the R2 value.

In the first stage of the experiment, it was found that better visibility of the carpal joint structures in MRI and USG examinations can be achieved in larger dogs with a body weight equal to or greater than 10 kg. The use of a dedicated carpal coil during MRI examination allowed for better contrast and image resolution compared to the use of a knee coil. The images obtained by MRI were consistent with other imaging methods. The ultrasonographic examination did not require pharmacological sedation of the dogs, and body position did not

affect the image quality. The flexor tendons of the superficial and deep digital flexor muscles and the medial accessoriometacarpal ligament were well visualized on MRI and USG images, enabling measurements to be made.

Most of the measurements performed on MRI images showed a strong correlation with body weight and thoracic limb measurements. Only two measurements in T2-weighted images in the sagittal plane showed a strong correlation with the animal's characteristics. Measurements of the joint structures performed on MRI images were most strongly correlated with body weight. Other thoracic limb measurement parameters also showed very strong and strong correlations with the measurements. Measurements of tendon diameters obtained from T1 and T2-weighted images showed a very strong agreement. The measurement of the deep digital flexor tendon diameter in the sagittal plane had the lowest coefficient of the agreement value. Measurements of the dimensions of the intermedioradial and accessory carpal bones showed a very strong agreement of measurements. Linear regression models were created to predict the measurements of carpal joint structures based on body mass and thoracic limb measurements. Body weight proved to be the most accurate predictor of the measurements of carpal joint structures. The models were validated, and the agreement between the measurements was presented.

In conclusion, the statistical analysis conducted demonstrated strong correlations between measurements obtained from images produced by different imaging techniques and body weight and thoracic limb measurements. Linear regression models were developed, allowing for the determination of standard dimensions of carpal joint structures based on anatomical parameters of the animal, such as body weight and carpus circumference. The application of such models in practice can significantly facilitate and expedite the diagnosis of injuries and diseases using imaging techniques.